

Desk Arrangement Effects on Pupil Classroom Behavior

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The purpose of this study was to evaluate experimentally the effects of desk arrangement on observed pupil behavior. The desk arrangements studied were rows, clusters, and circles. Using a time-sampling observation method, we observed three experimental classrooms of fifth- and sixth-grade students during discussion sessions in each of the desk arrangements. Three other classrooms of fifth- and sixth-grade students served as controls. In each classroom, male and female students of high and low ability and high and low classroom interaction were observed. Results confirmed hypotheses that students seated in circles engage in significantly more on-task behavior than those in rows and that students seated in clusters engage in more on-task behavior than those in rows but less than those in circles. Observed pupil behavior varied significantly across student types, as was expected.

Elementary classrooms have always had desks in them, but over the years the rows of identical desks bolted to the floor have given way to more flexible configurations over which teachers have gained considerable control. How to arrange the seating in a classroom and to what ends are questions that many teachers now answer for themselves. The decision is dictated by teachers' conceptions of their role, the conditions for learning, and the appropriate means for maintaining classroom control. Various teaching goals may conflict, however. For example, common sense indicates that grouping in small clusters would heighten student interaction but also might limit teacher control and/or encourage social interactions that are not conducive to learning.

Unfortunately, the educator who chooses to consult the available literature will find little that is helpful for making decisions about how to facilitate teaching-related goals through desk arrangement. Theoretical conceptions about the role of desk arrangement in the classroom have remained global. Sommer (1977) noted that although many teachers consider the classroom layout relatively unimportant when compared with the student-teacher relationship, the physical and social systems of the classroom are

inextricably interdependent. Getzels (1974) discussed how different desk arrangements presuppose differences among teachers in the ways they view students: A rectangular arrangement of fixed desks and the teacher at the front implies an empty learner to be filled with knowledge; a square arrangement with the teacher's desk at the side assumes an active learner; a circular arrangement assumes a social learner; and an open classroom assumes the stimulus-seeking learner who is a naturally curious problem finder. Getzels did not discuss the specific effects of these different desk arrangements on student behavior or consider the possibility, put into practice by many teachers, of changing seating arrangements for different purposes.

Empirical studies of the effects of desk arrangement on classroom behavior are also undifferentiated with respect to identifying particular cause-effect relationships. Zifferblatt (1972) counted the number of social comments between students and teachers during observations of two third-grade classrooms with teachers of a similar teaching style, using the same curriculum but with different seating arrangements and lessons. One classroom had from 2 to 12 desks in a cluster, and the other had 2 to 3 in a cluster. Zifferblatt found that large groups of desks facilitated social interaction but impeded individual work. He also found that barriers serving as boundaries for work and study areas impeded irrelevant verbal and visual

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exchanges, and that rugs in both classrooms encouraged informal interactions.

Winett, Battersby, and Edwards (1975) rearranged a sixth-grade classroom from individual one-piece chair-desks in rows to clusters of smaller desks with movable chairs in groups of eight. Each group was heterogeneous according to ability level. Along with these changes, math and reading instruction were individualized and group contingencies applied. An observational system with preset coding categories was used, including eight behavior codes pertaining to the child's work activity, four behavior codes related to the child's communication, and five behavior codes for affect-related behaviors. Changes in behavior and in academic performance were attributed to academic programming and to the use of group contingencies, but not to desk rearrangement or other architectural manipulations.

In her review of the research in this area, Weinstein (1979) did not find strong support even for the intuitively obvious assumption that a circle of desks would increase participation in discussion, partly because of numerous methodological flaws in the research. These included imprecisely defined and/or poorly operationalized independent and dependent variables and simultaneous manipulation of independent variables. These flaws were present in Winett, Battersby, and Edwards' (1975) research, in which uncontrolled variation occurred for spatial arrangement, the position of the teacher during lessons, and the method of instruction. Zifferblatt's classrooms similarly varied with respect to several spatial factors and lacked other controls necessary for definitive conclusions.

In addition to inadequate experimental procedures, the observation systems used in many of the cited studies did not adequately delimit the kinds of pupil behavior investigated. For example, more than half of the codes in the Winett et al. study focused on the child's work activity, which includes behaviors that are apt to be more affected by lesson assignments than by desk arrangements. Zifferblatt centered observations on social comments, which account for only a small part of the range of pupil behaviors commonly occurring in the classroom.

Starting with the constructivist assump-

tion that active participation of students is essential for developmental learning, the present study was designed to test hypotheses about the relative effectiveness of different desk arrangements for promoting student interactions identified as conducive to learning. Rows and clusters were selected as two of the desk arrangements for study because they are common in classrooms and because previous research refers to their effects on behavior. A third desk arrangement, circles, was selected because this configuration usually is considered to be conducive to discussion. The behaviors chosen for observation encompassed those that commonly occur in classrooms and were grouped into two main categories, on-task and off-task. On-task and off-task categories reflected pupil behavior directed, respectively, toward and away from the learning task. Within each of these main categories, behaviors were defined operationally for observation.¹ A time-sampling observation method, recording each observable behavior within a prescribed time, was used to collect the data on pupil behavior.

To control for the learning characteristics of the pupils, the students to be observed in each classroom were selected to represent differences in levels of verbal interaction and achievement and included both sexes. To control for instructional content, similar types of lessons were used for each observation. Also, to preclude changes in the position of the teacher during instruction from being the cause of observed behavior changes, the position of the teacher remained the same—at the front of the room—for all desk arrangements.

The primary hypotheses were (a) circles would be more conducive to on-task participation than rows, and (b) clusters would be less conducive than circles but more conducive than rows to on-task participation.

Method

Subjects

Subjects were students enrolled in 2 fifth-, 2 fifth/sixth-, and 2 sixth-grade regular classrooms in several

¹ The observation categories and their definitions are available from the authors.

elementary schools in a middle- to upper-middle-class, predominantly white district in Contra Costa County, California.

One classroom at each grade level was selected for the experimental classrooms in which desk arrangements were varied. The remaining three classrooms were identified as control groups. Each control group classroom was assigned to one of the three desk arrangements, whereas each experimental classroom experienced all three desk arrangements.

In each of the six classrooms, 8 students (4 boys and 4 girls) were selected to be observed: 2 high-ability (HA) and 2 low-ability (LA) students, and 2 high interactors (HI) and 2 low interactors (LI). *Ability* was measured achievement level. *Interaction* was defined as the amount of a student's verbal participation in class discussion.

To choose the high- and low-ability students, each teacher listed all boys and girls in the class whose overall mean achievement test scores exceeded +1 and -1 standard deviation from the overall mean score for their grade at the school. To select the high and low interactors, each teacher listed those boys and girls who participated most and least frequently in class discussion. From each of these lists, the observer randomly selected 1 boy and 1 girl for each of the four subject types per lesson. During the observation period, frequencies of observed behavior for each type of pupil were collected. The total number of children observed in the experimental desk arrangements was 24—12 boys and 12 girls. Eight children from each of three control classrooms were observed in only one desk arrangement.

The Lesson

Students were observed while brainstorming ideas for writing assignments. The writing assignments' topics were general enough that all students could contribute to a list of ideas that each could subsequently refer to to write his or her own essay. The teachers in the study had had previous training and experience using *Project Write* (Tanabe, 1974), the lesson discussion format. The *Project Write* protocol was used for listing and grouping ideas. Teachers were asked to call on students whose hands went up first, while simultaneously trying to call on less frequent interactors whenever their hands were raised. Discipline was to be handled in whatever manner the classroom teacher normally handled it.

Setting and Procedures

Three classrooms constituted the experimental group. For the first observation sequence, one had the seating arranged in clusters, another in rows, and a third in a circle. Figure 1 depicts these different desk configurations. *Clusters* were arbitrarily chosen desks arranged in groups of up to eight desks. For the second observation sequence, the first class was rearranged into rows, the second into a circle, and the third into clusters. For the third sequence, the first class was arranged in a circle, the second in clusters, and the third in rows. A control classroom was selected to match each of the three first observation sequences for the experimental classrooms. There was only one observation sequence

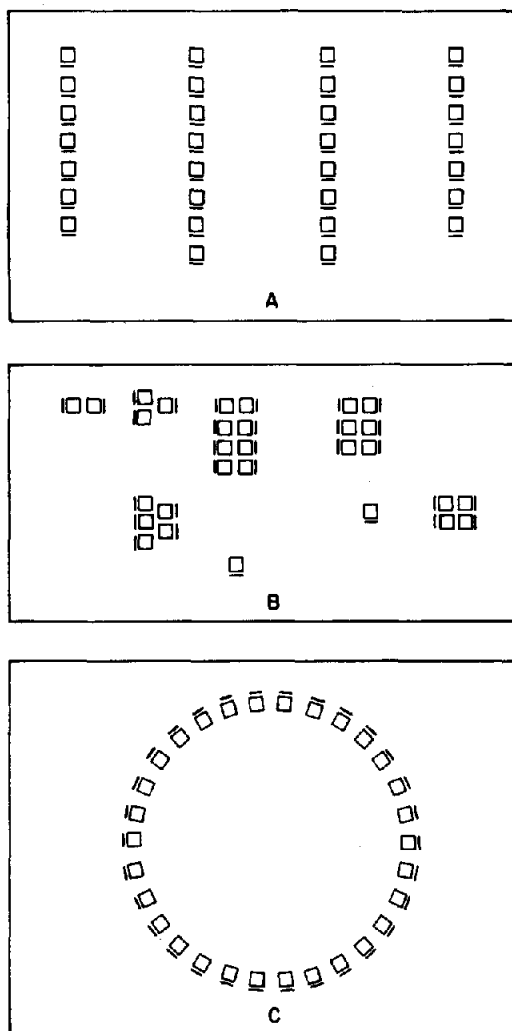


Figure 1. Desk arrangements. A = rows; B = clusters; C = circle.

and one desk arrangement in the control classrooms. The purpose of the control groups was to compare observed behavior in two classrooms that had the same seating arrangement, thereby providing a means for ruling out specific teacher and subject factors in making inferences about seating arrangements (see Table 1).

Observational Procedures

Each classroom observation sequence for each desk arrangement consisted of three 20-min lessons, totaling 60 observation minutes for each sequence. This made for 180 min of observation for each desk arrangement and for each experimental classroom. Since the experimental classrooms had three desk arrangements, these rooms were observed for a total of 540 min. Each control classroom had one observation sequence of three lessons for a total of 60 min observed in only one desk arrangement. There were, therefore, 240 min observation for each desk arrangement over all experimental and control classrooms.

A 20-min observation was broken down into twenty 60-s observation periods. During each 60-s observation, each child was observed once. The observer rotated through the 8 children until all were observed and then for the next 60-s observation repeated this process until 20 rotations of 60-s length had occurred. This made for 20 observations per student per 20-min period. Each 20-min observation for a class occurred on a different day.

The choice of a minimum of 60 min of observation for each desk arrangement was based on findings from Lambert and Hartsough's (1975) study of naturally occurring pupil behavior. From an analysis of frequency counts of behaviors of interest, Lambert and Hartsough were able to provide adequate estimates for the least frequently occurring behavior under study. Such estimates are the only requirements for determining total observation time needed when frequency count is the focus of observation (Altmann, 1974, p. 245). We hypothesized the least frequently occurring behavior in our study to be discussion comment and estimated it to occur once every 42 min²; therefore, 60 min of observation time was expected to provide adequate opportunity for the behavior to occur.

Pupil behaviors observed were divided between two main categories: on- and off-task. Within each category, behaviors were defined operationally so they could be observed in the classroom³ and recorded on a prearranged observation sheet. The Appendix provides the categories and the definitions of each observed behavior.

Results

Data Analysis

Table 2 presents the total frequencies of the behaviors observed in the classrooms.

Counts of pupil behaviors collected during observation were combined to incorporate very infrequently occurring behaviors with

Table 1: *Observational Sequences of Desk Arrangements for Experimental and Control Groups*

Group	Sequence		
	1 (Lessons 1, 2, 3)	2 (Lessons 4, 5, 6)	3 (Lessons 7, 8, 9)
5th grade			
Exp.	Cluster	→ Row	→ Circle
Control	Cluster		
5/6th grade			
Exp.	Row	→ Circle	→ Cluster
Control	Row		
6th grade			
Exp.	Circle	→ Cluster	→ Row
Control	Circle		

Note. Exp. = experimental.

Table 2
Total Frequencies of Behaviors Observed and Used in Analyses

Behavior	Frequency	
	Observed	Used in analysis
On-task		
Out-of-order comment		333
Out-of-order comment	178	
Speaking	155	
Discussion comment		157
Involuntary	154	
Response	3	
Questioning/pupil request ^a		1
Teacher	1	
Pupil	0	
Teacher and pupil	0	
Total oral response ^b		491
Hand-raising	873	873
Listening	3,354	3,354
Total		4,718
Off-task		
Disruptive behavior		251
Aggression		
Insulting/teasing	4	
Yelling	2	
Fighting	1	
Disruptive conduct	244	
Withdrawal	791	791
Total		1,042

Note. Frequencies are based on 8 observations per minute for 720 min.

^a This behavior, although observed, was not analyzed independently. However, it was analyzed as an element of the on-task oral response category.

^b This figure is the sum of the three values above.

closely related behaviors. The resulting nine groups of pupil behaviors were used as dependent variables in 2 one-way analyses of variance: one with desk arrangement as the independent variable and the other with

² This frequency of behavior was calculated from behavior frequency counts established in fifth-grade reading studies from the report by Lambert and Hartsough (1975, pp. 50-52, 83). We planned to combine other observed behaviors thought to occur less frequently than discussion comment with other behaviors during the subsequent data analysis.

³ These pupil behaviors were chosen for observation based on data collected by the Apple Observation System in *Beginning Teacher Study* by Lambert and Hartsough (1975).

Table 3
Average Frequency of Observed Behavior by Desk Arrangement

Behavior	Rows	Cluster	Circle	Significant contrasts ^a
On-task behavior				
Hand-raising	2.82	3.40	2.35	cluster > circle
Listening	11.85	11.72	12.40	ns
Discussion comment	0.50	0.50	0.68	ns
On-task out-of-order comment	0.67	1.25	1.60	circle > rows
On-task oral response	1.18	1.76	2.28	circle > rows
Total	15.78	16.89	17.03	cluster > rows circle > rows
Off-task behavior				
Disruptive behavior	0.62	0.68	0.69	ns
Withdrawal	3.54	2.43	2.28	rows > cluster rows > circle
Total	4.17	3.11	2.97	rows > circle

Note. Average frequency was based on number of observed behaviors during a total of 540 min of observation.

^a Tukey's tests were used to calculate these significant contrasts, $p < .05$.

student type as the independent variable. The nine pupil behavior dependent variables were hand-raising, listening, discussion comment, on-task out-of-order comment, on-task oral response, on-task, disruptive behavior, withdrawal, and off-task. The program MULTIVARIANCE (Finn, 1980) was used for the analyses. When a significant F value ($p < .05$) was obtained from the analysis of variance, Tukey's post hoc tests were

computed to locate the group means that differed significantly.

Effects of Desk Arrangement on Pupil Behavior

Table 3 presents the mean frequencies for each pupil behavior for rows, clusters, and circles.

No significant differences attributable to

Table 4
Average Frequency of Observed Behavior by Type

Behavior	HIB	HIG	LIB	LIG	HAB	HAG	LAB	LAG	Sig. of F
On-task behavior									
Hand-raising	3.80	4.61	1.72	1.42	2.06	3.55	4.00	3.36	.0001
Listening	10.03	10.61	12.25	13.69	13.63	11.69	7.91	12.83	.0001
Discussion comment	0.58	0.94	0.47	0.19	0.64	0.58	0.58	0.36	.0120
Out-of-order comment	1.86	1.30	0.75	0.64	0.97	1.22	1.69	0.83	.1261
Oral response	2.44	2.25	1.17	0.83	1.61	1.83	2.31	1.19	.0169
Total	16.31	17.50	15.31	15.89	17.36	17.06	14.22	17.42	.0001
Off-task behavior									
Disruptive behavior	1.28	0.69	1.33	0.80	0.56	0.72	1.53	0.28	.0381
Withdrawal	2.47	1.83	3.53	3.31	2.08	2.22	4.22	2.31	.0006
Total	3.69	2.50	4.69	4.11	2.64	2.94	5.78	2.58	.0001

Note. Average frequency was based on number of observed behaviors during a total of 720 min of observation. HIB = high-interacting boy; HIG = high-interacting girl; LIB = low-interacting boy; LIG = low-interacting girl; HAB = high-achieving boy; HAG = high-achieving girl; LAB = low-achieving boy; LAG = low-achieving girl.

desk arrangement were found for listening, discussion comment, or disruptive behavior. Differences reflecting desk arrangements were found for the remaining behavior categories. In three categories, circles produced a greater number of on-task out-of-order comment, on-task oral response, and on-task behaviors than did rows. The cluster arrangement produced a greater number of on-task behaviors, and more hand-raising, than did rows. The row arrangement produced a greater number of withdrawal responses than the clusters or circle and more off-task responses than the circle.

Student Type Differences in Pupil Behavior

Table 4 presents the average frequencies for each pupil behavior for the eight types of students observed, regardless of grade level and seating arrangement.

The behavior of low-achieving boys differed from that of other student types, especially low-achieving girls. Low-achieving boys more frequently engaged in disruptive behavior than did low-achieving girls and showed more withdrawal and off-task behavior than other students. Conversely, low-achieving boys less frequently engaged both in listening and on-task behavior.

Other student types showed significant variation from one another. Low-interacting boys performed more off-task and less on-task behaviors and hand-raising than other students. Low-interacting girls exhibited hand-raising less often than other students. High-interacting boys had fewer listening responses than most other student types and more on-task oral responses than low-interacting girls. High-interacting girls showed more discussion comment than both low-interacting and low-achieving girls. High-interacting girls, however, engaged less often in listening than high-achieving boys and low-interacting girls. Finally, high-achieving boys demonstrated less frequent hand-raising than high-interacting girls and low-achieving boys.

Discussion

The results demonstrated that desk arrangement, and not student ability, student

interest, observer bias, or other architectural features, significantly affected pupil behavior. To minimize subjective influences on observation, a time-sampling observation system with operational definitions of behaviors was designed and effectively utilized. Further, the means for observed behavior in the control classroom did not vary significantly from the means for the experimental classroom using the same seating arrangement.

Teachers who wish to facilitate pupil interaction during discussion sessions would be wise to consider arranging desks in circles. In this study, circles facilitated on-task response as well as on-task out-of-order comment, suggesting that more active participation of students for developmental learning is affected positively by circles rather than row seating. Both clusters and circles more positively influenced total on-task oral responses; however, the fact that there was more hand-raising in clusters than in circles suggests that pupils seated in clusters who were actively involved in the class discussion had to raise their hand to get attention, whereas those in circles simply made more on-task out-of-order comments.

Teachers need not fear an unruly class discussion when pupils are seated in a circle. On-task out-of-order comments increased in circles, but students' comments pertained to the task at hand. Desks in rows produced more withdrawal and off-task behavior; therefore, if the teacher wishes to involve students interactively in intellectual material in classroom discussions, children at desks in rows are least likely to be induced to interact with the lesson material.

Although no significant interactions between seating arrangement and low- and high-ability and low- and high-interacting pupils were found, there were some interesting findings regarding differences in observed behavior during discussions between student types. The means for low-achieving boys were significantly greater than the means for low-achieving girls for disruptive behavior, withdrawal, and off-task responses; the means for low-achieving girls were greater for listening and on-task behavior. Low-achieving girls typically were more attentive to discussion, whereas low-achieving boys were typically engaged in off-task activities. Similar sex-related dif-

ferences existed between high- and low-interacting boys and girls. During discussions, behaviors of low-interacting boys were more likely to be observed as withdrawal and off-task. Low-interacting girls, on the other hand, were observed to behave appropriately by listening, but the crucial element of observable interactions was absent for them as well as for the low-interacting boys.

Desks arranged in circles during classroom discussion can facilitate interaction as well as control for off-task behavior of pupils. The results suggest that desk arrangement influences participation, thinking, and appropriate comments, which in turn can have a positive effect on learning. There were, however, sex-related differences in classroom behavior that were not accounted for by level of achievement, interaction level, or seating arrangement.

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Appendix

Observational System: Operational Definitions of Pupil Behaviors

On-task

Behaviors defined as on-task include actions directed toward solving the academic problem and verbal or physical actions contributing constructively to class academic activity.

Hand-raising. Student raising hand to make a contribution to discussion.

Discussion comment. Any other verbal act joining in discussion of common problem or issue as part of the class academic activity. The verbal act can be either (a) a response to a question or comment directed specifically to the individual by the teacher or another student, or (b) voluntary comment, either spontaneous or in response to a general call by the teacher or student for volunteers.

Questioning/pupil request. Student asking question regarding the academic problem; student stating wish or request concerning academic activity. Directed to peer(s) and/or teacher.

Listening. Act of paying attention to the subject being taught or discussed as shown through physical orientation or gestures (e.g.,

student leaning forward attending to discussion).

Out-of-order comment. Any verbal act attempting to join in discussion of common problem or issue as part of the class academic activity without following proper procedure of raising hand and being called on before talking; rather than raising hand to be called on, the student gives answer out of turn and possibly interrupts someone else who is speaking after having been called on.

Speaking. Examples of verbal behavior that are not prohibited and do not fit into other on-task categories for oral actions.

Off-task

Behaviors defined as off-task include actions not directed toward solving the academic problem and verbal or physical action not joining constructively in class academic activity.

Disruptive conduct. Behaviors, not necessarily intentional, that disrupt the activities of the classroom or individual students. Behaviors clearly disruptive and unable to fit in another category.

Withdrawal/disassociation. Detachment from the ongoing activity, implying disassociation from all ongoing activity; uninvolved in on-task or aggressive behaviors or disruptive conduct.

Aggression. Verbal or physical hostile actions:

1. **Insulting/teasing.** Calling another student abusive names; making fun of another's failure to perform or complete a task; ridiculing; directing insults at recipient. Verbal or physical behavior designed to goad another person; harping on

something which makes another feel embarrassed, guilty, inferior, or annoyed.

2. **Yelling.** Loud or boisterous verbal activity that disrupts class.

3. **Fighting.** Extreme physical acting out of aggression between two or more people; hitting or striking others.

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